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ABSTRACT

The learning performance of college students given computer-assisted instruction (CAI) was investigated. Three introductory psychology lessons of 35 frames each were administered to matched groups under two modes: a) CAI mode (N = 15), and b) printed programed instruction mode (N = 11). Both lesson modes produced significant learning. Although no mean differences between modes was found, CAI mode produced significantly higher variances in learning performance (p = .01). Changes in attitudes toward computers and aspects of the subject matter were found to significantly covary with learning performance under the CAI mode (p = .05). The study provides information to guide the design of future CAI applications on the college level. (Author)

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COVARIATES OF LEARNING IN COMPUTER-ASSISTED INSTRUCTION[1]

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Purpose

The utility of computer-assisted instruction (CAI) in an introductory college psychology course was investigated. The need for such validation studies of CAI has been strongly established by Oettinger and Marks (1969). Measures of student learning were compared for two matched groups, one taking CAI lessons, and one taking an inexpensive written version of the CAI lessons. Measures of student attitudes before and after instruction were used to study the interaction of attitude change and learning performance. Pretests of verbal intelligence and other aptitudes were used to study the relation of student characteristics to performance.

Methods

A CAI author language and operating system was designed for the IBM 360/65 RAX time-sharing system at McGill University. The capabilities and structure of the language are similar to LYRIC (Silvern, 1968). Computer terminals used were Teletype Model 33.

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Three CAI lessons of approximately one hour each were prepared. Portions of the lessons involved branching and remedial instruction, and were designed as basically frame-by-frame instruction requiring the student to respond by typing in a word or phrase. Each lesson involved approximately 35 frames of varying size some referring to accompanying diagrams.

A parallel set of lessons was prepared by making a written version of the CAI lessons, which required the reader to make covert responses only after each fifth frame.

Subjects were obtained from a pool of 120 students whose scores on a midterm objective test in an introductory psychology course were 44% (36/82) or below. Twenty-six students volunteered for the experiment and were assigned randomly to one of two treatment groups: (a) An experimental group of 15 (10 males, 5 females) given the CAI lessons, and (b) a control group of 11 (7 males, 4 females) given the written versions of the CAI lessons. The following measures were taken for each student during five experimental sessions held one week apart:

1. Pretests and posttests of learning (10 items each) for each of three lessons. (Sessions 2-4)

2. A 30-item final posttest measuring retention on all lessons. (Session 5)

3. Pre- and post-measures of attitudes toward computers, psychology, and other aspects of technology and the course subject matter. Semantic differential technique was used and scores were obtained for each of the target words and each of the factors listed in Table 1.

Insert Table 1 about here

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4. Terman's Concept Mastery Test (CMT). (Session 1)

5. Student evaluations of the instructional materials. (Sessions 2-4)

6. For subjects in the experimental CAI group, a measure of speed and accuracy of typing on the computer terminal. (Session 1)

Results

Significant increases between pretest and posttests of learning were found for each CAI lesson in the experimental group ($p = .01$, using the Wilcoxon matched-pairs, signed-ranks test), and for the last two of the written lessons in the control group ($p = .02$ and $p = .01$). A multivariate analysis of covariance using lesson posttests of learning as dependent variables and lesson pretests as covariates revealed no significant differences between experimental and control groups. An additional analysis using CMT scores and sex as covariates also showed no significant difference.

However, an examination of residual change scores (posttest standard score minus pretest standard score multiplied by the correlation between pretest and posttest) for each lesson showed that although there were no mean differences between groups, the CAI group showed significantly higher variance in change scores on two of the three lessons (p = .01, using F ratio test).

Residual change scores were computed for pretest and posttest measures of attitudes. Change scores for each semantic differential factor for each target word were obtained. Change scroes on the understandability factor for the words "computer" and "computer programmer" were found to significantly covary (r's of .41-.59, p = .05) with learning (lesson change scores) in the CAI group. Change scores on the understandability factor for words such as "nervous system" and "cell assembly" (key concepts taught in the lessons) significantly covaried (r's of .38-.40, p = .05) with learning performance in both groups.

All subjects rated the value of the lessons in very positive terms indicating particularly the value of immediate feedback and the logical sequence of frames. No differences were observed between experimental CAI and control groups on student evaluations of the value, positive aspects or negative aspects of the lessons. These subjects had apparently not had prior exposure to either CAI or written programmed instruction of the type provided.

Pretest measures of manual skill in operating the computer terminals were inspected in the CAI group. Neither typing speed nor typing accuracy significantly interacted with learning performance on any of the CAI lessons or on the final posttest covering all lessons.

Discussion

In terms of cost-effectiveness the simple, written versions of the CAI lessons, not computer administered, proved superior for two out of the three lessons. Records of computer time charges showed that the CAI lessons cost nearly 50 times ($900. vs. $20.) that of duplicating and scoring charges for the written lessons. It should be kept in mind, however, that the type of CAI used (viz, frame-by-frame programmed instruction) is more easily translated into written form than other CAI modes (e.g., tutorial or simulation-games).

The finding that the learning performance of students in the CAI group varied to a much greater extent than that of students taking the written version is similar to a result observed by Wassertheil (1968) for computer assistance in a college statistics course.

The finding that prior typing ability and manual skill in operating the computer terminal did not influence learning is an encouraging indicator for educators planning implementation of teletype-oriented CAI systems.

References

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Footnote

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TABLE 1

SEMANTIC DIFFERENTIAL ATTITUDE MEASURE

Target words		
Arousal	Psychology	Technology
Nervous system	Intelligence test	Computers
Cell assembly	University	Computer programmer
Conditioned Response		

Factors	Factor Scales
Evaluation	valuable--worthless
	useful--useless
	pleasant--unpleasant
Understandability	simple--complex
	well-defined--ambiguous
Potency	safe--dangerous
	controlled--uncontrolled